

KTC

**2002
Annual Report**



UNIVERSITY OF KENTUCKY

College of Engineering

Kentucky Transportation Center

Kentucky Transportation Center Annual Report 2002

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Kentucky Transportation Center

Our Mission

We provide services to the transportation community through research, technology transfer and education.

We create and participate in partnerships to promote safe and effective transportation systems.

We Value...

Teamwork

Listening and communicating along with courtesy and respect for others.

Honesty and ethical behavior

Delivering the highest quality products and services.

Continuous improvement

in all that we do.

Message From the Director



*Paul Toussaint, Director
Kentucky Transportation Center*

We constantly strive to demonstrate the value of transportation research and innovation to our customers. President Todd has challenged all of us at UK to be responsive to the needs of our state. At the Center, we seek excellence in transportation research and technology transfer as our contribution to making a good transportation system even better. We work closely with Kentucky's Transportation Cabinet as well as other state agencies and have customers well beyond the boundaries of Kentucky.

Our mission is carried out in several ways. First, through the efforts of a dedicated staff that offers training and technology transfer to thousands of persons (locally and nationally) that design, operate and maintain our network of highways. Second, through an experienced research staff that is constantly seeking new and better ways to improve the processes and components for developing our highway infrastructure. In the long run, even modest improvements in transportation products, specifications, and construction processes will reap huge dividends. Research is the catalyst that leads to a more effective use of our transportation assets. Lastly, we at the Center continually seek to enhance the educational experience of the next generation of transportation professionals. We do this by giving students hands-on experience while assisting with applied research projects and increasingly exposing them to new thinking in the classroom.

The past year has been an exciting one for the Center. We have made strides in each of those areas that will make the University, the people of the Commonwealth and the transportation system in Kentucky the envy of every state. This annual report provides a brief glimpse of the activities of the Kentucky Transportation Center that make all this possible.

Message From the Kentucky Secretary of Transportation

A safe, modern and efficient transportation system is the key to success in the Commonwealth. We must focus on adequate funding for the program to address safety, congestion, capacity expansion, environmental stewardship and the numerous other needs across the state.

We are being challenged to speed up roadway improvements while being sensitive to both the human and natural environments of our communities. Research holds the promise of finding new ways or refining old ways of doing things that are more effective and efficient. This is the value of research. I appreciate the research, demonstration, and technology transfer work done by our Kentucky Transportation Center. The results of applied research as well as the professional development and training offered has helped us find better solutions and make significant progress this past year.

The Center's work contributes to meeting our responsibility to build efficient transportation facilities in more livable communities. Transportation is important to Kentucky's economic development. We must use common sense and do it right. Kentuckians deserve no less.



*James C. Codell III
Kentucky Transportation Secretary*

Value of Construction Engineering and Management Research

Major 2002 Projects

- Context Sensitive Construction
- Contractor Performed Quality Control
- Constructibility Issues for KyTC Projects
- Contractor Prequalification Implementation



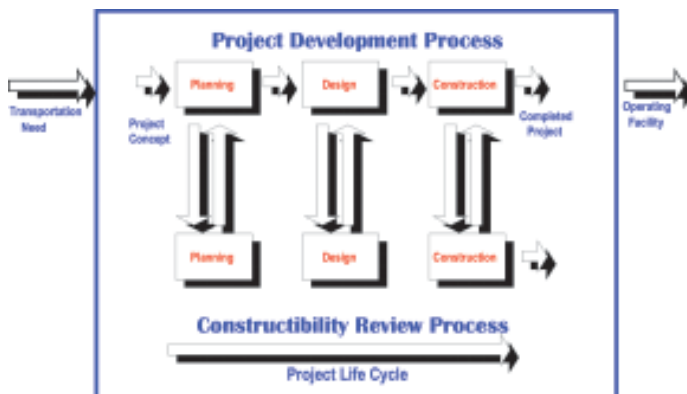
About their value...

A workshop was developed in conjunction with Cabinet personnel to introduce resident engineers and contractors to the need for and practice of environmentally sensitive practices on roadway construction projects.

An evaluation was made of the current efforts to transfer quality control responsibilities from the Transportation Cabinet to contractors on KyTC projects. Recommendations were given for continued implementation of this practice.

A study was initiated to determine how to best integrate constructibility reviews into the KyTC project development process, and to capture past project lessons for future project improvement.

Trial implementation of a quality-based project performance evaluation system was conducted, and assistance given to develop a web-based program to facilitate the use of the system by the Cabinet on a permanent basis.



Value of Environmental Analysis Research

Major 2002 Projects

- Variations Between Design and Construction That Impact Environmental Commitments
- Environmental Impacts of Bridge Cleaning Operations
- Case Study of 4F Litigation and Rulings
- Evaluation of Methods to Protect Water Quality in Karst Areas
- Safety and Health Concerns for KyTC and Contractor Personnel
- Survey of Welding Processes



Erection of waste containment on a Kentucky bridge prior to painting

An experimental filtering system used to purify waste water from bridge painting



An experimental Karst site adjacent to I-65 in Warren County

About their value...

Environmental research aims to focus on critical environmental issues and provide cost-effective solutions. This research is driven by the Transportation Cabinet's desire to ensure that its activities have minimal impacts on the environment while fulfilling its primary role of providing safe and reliable transportation.

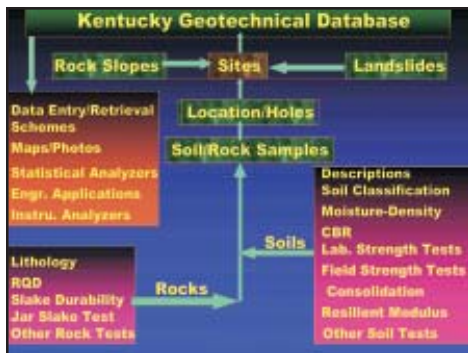
Water-quality research is being conducted on several issues. Waste water generated by bridge-cleaning operations poses concerns due to potentially high concentrations of heavy metals. Innovative methods of collecting and cleaning the waste water are being investigated.

Current research also is addressing groundwater quality along highways located in areas possessing karst geological formations. This work is aimed at developing viable methods for capturing pollutants from highway runoff before they can reach the porous karst sites and enter groundwater sources. Additional research is addressing a variety of environmental and worker safety issues.

Value of Geotechnical Research

Major 2002 Projects

- Long-Term Benefits of Stabilizing Highway Subgrades
- Geotechnical Database of Kentucky
- Reduction of Stresses on Buried, Rigid, Highway Structures Using the Imperfect-Ditch Method and Expanded Polystyrene (Geofoam)
- Resilient Modulus of Kentucky Soils
- Corrosion Evaluation of Mechanically Reinforced Walls
- Bearing Capacity Analysis and Design of Highway Base Material Reinforced with Geo-fabrics
- Investigation of Soft Zone in Highway Subgrades



About their value...

Engineering properties of soils and rocks are highly variable. As a result, building roadways with these materials poses design and construction problems. One way to evaluate the behavior of highway materials in future construction is to analyze their past performances. Recognizing where landslide and rock slope failures have occurred and the engineering properties of the different types of materials involved is important for improving future highway design and performance.

The Kentucky Geotechnical Database is being developed to capture the large amount of geotechnical engineering data generated yearly by the Transportation Cabinet and to store landslide and rock slope engineering information. Over 1,300 highway landslides and 2,100 potentially hazardous rock slope sites have been identified. Attributes of each site, including photographs, have been compiled in the client-server database.

New techniques and procedures for analyzing and repairing landslides and rock slopes are under development. Selected sites have been mapped using lasers connected to Global Positioning System (GPS) equipment. Some repaired landslides are being monitored with survey-grade, GPS equipment to track movements and determine if repairs are working.

Value of Intelligent Transportation Systems (ITS) Research

Major 2002 Projects

- A Qualitative Assessment of the Lexington Automated Incident-Detection System
- NORPASS National Program Support
- Deployment of a Virtual Weigh Station
- Development of an ITS Maintenance and Management Plan
- Analysis of ITS Procurement Processes
- Development and Testing of an Integrated Commercial Vehicle Safety System



Mid-America truck show



*Trucks in rural
Simpson County*



*Commercial vehicle
identification equipment*

About their value...

Intelligent Transportation Systems, or ITS, refers to any application of advanced technology to improve the safety, comfort, and efficiency of surface transportation. Since the early 1990s, the Commonwealth and the Center have enjoyed positions of national prominence in the field of ITS.

ITS projects that are underway now will change the future of transportation in Kentucky and throughout North America. One example is the Virtual Weigh Station currently being installed in southern Kentucky. This technology has the potential to change the way commercial vehicle enforcement is conducted, allowing enforcement personnel to monitor many more routes and creating a more "level playing field" for motor carriers operating in Kentucky.

In cooperation with the Lexington-Fayette Urban County Government, the Center is evaluating alternative technologies to monitor traffic and automatically detect incidents. This technology has the potential to speed incident detection and response, thus reducing delay and enhancing safety for all travelers.

Value of Pavements and Materials Research

Major 2002 Projects

- Evaluation of Current Incentive/Disincentive Procedures
- Evaluation of NDT and Geo-Physical Techniques for Subsurface Investigations
- Evaluation of Aggregate Segregation
- Evaluation of Drainage Systems for Rehabilitated and Resurfaced Pavements
- Development of Pavement Rehabilitation and Resurfacing Warrants



*Traffic delay
evaluation
for project
incentive
determination*

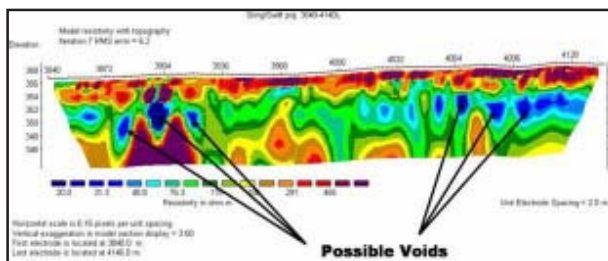
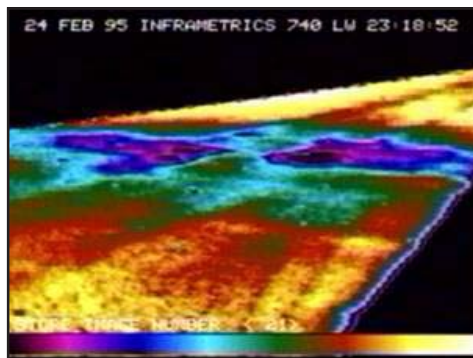
About their value...

The use of incentives and disincentives on construction projects promotes the innovation of construction and traffic management techniques. Increasing traffic trends continue to require these innovations to meet the traveling public's expectations of limited disruption of service for construction and repairs.

As the highway industry moves toward higher-performing pavement structures, a better understanding of the attributes which affect performance is required. Both thermal and aggregate segregation affect the performance of asphalt pavement structures. A detailed analysis of the issues surrounding segregation and methodologies to objectively evaluate its extent will allow for the design and construction of improved highways.

To insure the most cost-effective utilization of available funding in the construction of new roadway alignments, a detailed understanding of the underlying features is required. The use of ground-penetrating radar, resistivity and microgravity allows engineers to gain additional understanding into the subsurface characteristics (buried utilities, cave-ins, mines, etc.) which can lead to costly project overruns and delays if not identified during project design.

*Pavement
thermal
segregation*



Subsurface investigation using resistivity

Value of Policy and Systems Analysis Research

Major 2002 Projects

- Community Design of a Light-Rail, Transit-Oriented District (TARC)
- Kentucky Abandoned Rail Inventory
- Highway Adequacy Rating Study
- Commercial Vehicle Information Systems & Networks Outreach
- Transportation Systems Management Graduate Certificate Program
- Kentucky Highway User Survey
- Federal Motor Carrier Safety Administration Workshop Series
- Intermodal Management System Database and Directory

Conducting abandoned rail inventory

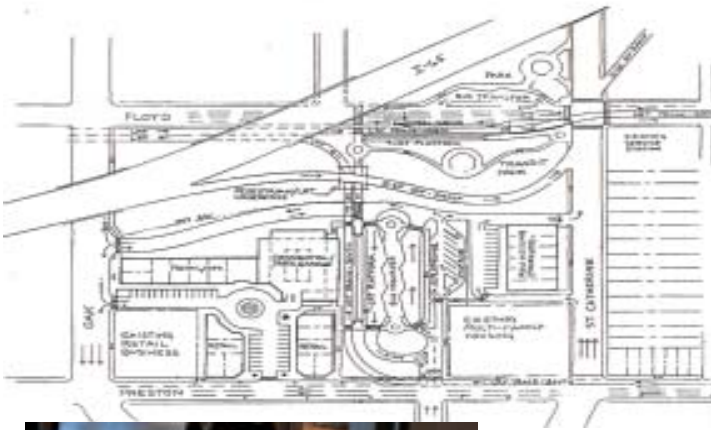


About their value...

The Policy and Systems Analysis Team has provided logistical support and facilitation for the Commercial Vehicle Information Systems and Network Workshop Series for the past four years. Over 40 states have completed the program with each having produced a comprehensive business plan for improved commercial vehicle operations.

The PSA team also has a National Academy of Science grant to combine virtual reality, electronic polling, and decision modeling in a community design project. PSA is partnering with the Transit Authority of River City (TARC), the UK College of Architecture and the Urban Design Studio of Louisville to help Louisville neighborhood residents design their own light-rail, transit-oriented development.

The purpose of the Kentucky Highway Adequacy Rating project is to formulate a methodology for adequacy ratings within Kentucky based on factors that affect roadway performance, such as lane width, volume, percent trucks, accident history, etc., with the importance of each factor being set by a panel of experts. This methodological approach is now an important tool in setting the Transportation Cabinet's long-term performance measurement of the state's highway system.

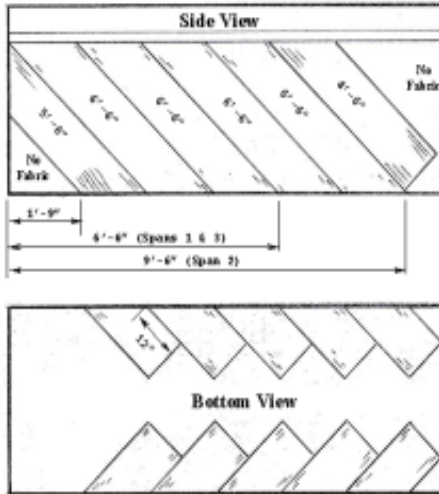


Structured Public Involvement allows complex design issues to be considered by public groups using visual analysis techniques and decision modeling concepts. A prototype application was developed and tested for an area of planned transit oriented development. The successful application was focused on TARC's plan for a light-rail system in Louisville and the Preston St./Catherine Station. This method allowed local citizens and project designers to interact in a systematic way that was beneficial to both. It gives the public a better way to communicate their preferences and the designers better information for making responsive design decisions.

Three Research Projects



- Concepts
- Technologies
- Materials



Innovative Bridge Materials can be used to repair bridges without taking them out of service or disrupting traffic. Using aerospace composite fiber sheets, a bridge's concrete beams can be repaired at a reasonable cost and even strengthened beyond their original design. This demonstration project in Carter County successfully used CFRP materials in an engineered system that filled the cracks and covered them with fiber 'cloth' sheets and resin. The estimated saving for this project was \$400,000 and it was done without traffic disruption.

(Newspaper article reprinted with permission from **The Ashland Independent**, Ashland, KY)



A Virtual Weigh Station can provide covert enforcement and extend enforcement coverage to many more routes at a fraction of the cost of a standard weigh station. The combination of a remote monitoring system for commercial vehicles combined with weigh-in-motion equipment makes it difficult for violators to avoid detection. The Center has worked with Kentucky's Department of Vehicle Regulation to prototype this concept using state-of-the-art technology. A 'real' weigh station costs \$3-5 million while a virtual weigh station costs less than \$150,000.

Innovation and service beyond expectation ...

Value of Structures Research

Major 2002 Projects

- Seismic Evaluation of Bridges on I-24
- Testing and Modeling of Maysville Bridge
- Evaluation of the Roebling Bridge
- Barge Impact Loading on Bridges
- Post-Earthquake Investigation Training
- Carbon Rebars in Bridge Decks



About their value...

Research in the Structures area focuses primarily on seismic evaluation of bridges in Western Kentucky. Over 500 bridges on and over I-24 and the Western Kentucky Parkway are under study to determine their capability of resisting projected earthquakes. When required, retrofit measures will be proposed for bridges to insure their survivability during a seismic event. In addition, post earthquake investigation training will be offered to engineers throughout the state.

Research also has been carried out to evaluate and deploy advanced fiber reinforced polymer (FRP) composites, especially in the area of bridge deck reinforcement and strengthening of existing structures. FRP components will be one of the construction materials in the 21st Century.

Structures research leads to safer bridges in the Commonwealth and the nation, and to more cost-effective investments of public funds.

Value of Traffic and Safety Research

Major 2002 Projects

- Impact of Large Trucks on Interstate Highway Safety
- Driver Opinions and Attitudes Related to Highway Safety
- Safety Implications from Design Exceptions
- Identification of High-Traffic Crash Corridors
- Safety Related to Bypasses
- Context-Sensitive Solutions for Construction



Context-sensitive solutions



About their value...

Traffic and Safety Research focuses on the analyses of highway safety features and programs to improve safety. Analyses and evaluations are conducted at specific high-crash sites, corridors, or on a statewide basis. Safety improvement initiatives (with specific counter-measures) address the economic and personal losses associated with highway crashes and injuries.

A recently completed study of truck safety on interstates suggested several countermeasures to improve the highway infrastructure and the mechanical functioning of trucks (with increased applications of electronic technology).

A method has been developed for the identification and analysis of high-crash corridors based on length, volume of traffic, number of crashes, and crash rates. A case study demonstrated the value of this method for selecting improvements related to engineering, education, and enforcement.

Extensive training has been conducted for context-sensitive design that balances concerns for safety and environment.

Value of Technology Transfer

Major 2002 Projects

- Revised and updated two training workshops
- Added 1,309 items to library holdings
- Presented 156 workshops attended by 5,815 transportation workers
- Issued quarterly newsletter
- Developed new training and information materials including new video catalog
- Developed software program to assist governmental agencies establish rural road/street system values to comply with new federal regulations
- Built a new, productive Web site (www.kyt2.com) with the capability for workshop participants to register and pay for workshops/materials online by credit card
- Revised the *Traffic Control in Work Zone Guide* to comply with new federal guidelines



Training workshop

About their value...

The Technology Transfer (T²) Program assists those who manage and maintain Kentucky's highways tap into needed resources so they can operate more efficiently and safely. A phone call to T² can provide how-to manuals, expert advice, legislative and regulatory news, more than 25 different training workshops, on-site technical assistance, and access to the only transportation library in the Commonwealth.

On-site technical assistance



T² is Kentucky's Local Technical Assistance Program (LTAP) center and receives funding from the Federal Highway Administration's LTAP program, as well as support from its partners, the Kentucky Transportation Cabinet and the University of Kentucky.

This fiscal year, T² assisted with the development and presentation of the first Kentucky Aviation Maintenance and Operations Seminar and assisted in delivery of the Governor's 2001 Highway Safety Summit.



Library resource information

Value of Revenue Analysis

The Fuel Tax Compliance Unit was established in December 1999 to assist the Kentucky Transportation and Revenue Cabinets in addressing fuel tax and road-fund tax compliance issues.

This fiscal year the Unit has processed approximately 50 audits for the Transportation Cabinet, resulting in assessments in excess of \$2 million. The audits were on trucking firms with IFTA (International Fuel Tax Association) miles and vehicles with Kentucky Weight-Distance miles. In the short period the Unit has been working with the Revenue Cabinet, it has worked on approximately 20 audits resulting in small assessments. Most of the work to this point has been developing new audit procedures and studying areas where there are potential compliance problems.

Two new databases were developed for the Transportation Cabinet that have made tracking errors in tax returns easier. A system was developed to download IFTA returns from other states enabling the auditors to check for errors on both Kentucky IFTA returns and Kentucky Weight-Distance returns. The Unit assisted in the development of a program to match vehicle registration to road usage permits issued for those vehicles. This enables an auditor to identify vehicles that are using our roadways without obtaining proper permits or paying the appropriate tax fees.

Financial Snapshot

FY 2002 Expenditures*

Program Area Category	Research**	Technology Transfer	Advanced Institute	Special Administration	Total Category
Personnel	3,527,428	359,224	47,375	49,944	3,983,971
Operating	1,515,945	493,252	5,467	29,345	2,044,009
Equipment	134,405	7,202	0	0	141,607
Indirect Costs	1,001,632	0	2,494	0	1,004,126
Total Program	6,179,410	859,678	55,336	79,289	7,173,713



Distribution by Program Area



Distribution by Category

*Expenditure detail by subcategory of expense is available on request (1-800-432-0719) or on the Center's Web Site: www.ktc.uky.edu

**The research/study program for FY02 consisted of over 100 projects conducted for the following agencies: the Kentucky Transportation Cabinet, Kentucky State Police, USDOT/FHWA, USDOT/FMCSA, NHTSA, NCHRP, BTS, TCRP, NORPASS, TARC (Louisville), Miami Valley Regional Planning Commission, Lexington-Fayette Urban County Government, and various private firms. Some work is done in cooperation with other universities including: Northwestern, University of Connecticut, University of Louisville, UT/Knoxville, Georgia Tech, University of Michigan, Calspan-UB Research Center, and Johns Hopkins; and also in partnership with private firms including TRW.

2002/2003 Kentucky Highway Research Projects

- Effect of Pavement Resurfacing on Traffic Safety (Study #03-257)
- Traffic Crashes at Intersections (Study #03-258)
- Effect of Warning Signs on Operating Speeds (Study #03-259)
- Implementation of Remote Sensing Technology (Study #03-260)
- Multi-Barge Flotilla Impact Forces on Bridges (Study #03-261)
- Lessons Learned on KyTC Construction Projects (Study #03-262)
- Kentucky Highway User Survey (Study #03-263)
- State Traffic Volume System Count Estimation Process (Study #03-264)
- Evaluation of Kentucky's Pavement Management System and Maintenance Rating System (Study #03-265)
- Utilization of Pavement Profiling Equipment to Determine As-Built Transverse and Longitudinal Profiles of Existing Highways (Study #03-266)
- Development of Pavement Distress Manual (Study #03-267)
- Safety and Health Concerns for Cabinet and Contractor Personnel: Phase I (Study #03-268)
- Survey of Welding Processes (Study #03-269)
- Characteristics and Engineering Properties of the Soft Soil Layer at the Top of Highway Soil Subgrades (Study #03-270)

Research Reports Published During FY 2002

Evaluation of High Traffic Crash Corridors, Eric G. Green and Kenneth R. Agent, March 2002. (KTC-02-08/SPR231-01-1F)

Safety Implications from Design Exceptions, Kenneth R. Agent, Jerry G. Pigman and Nickiforos Stamatiadis, March 2002. (KTC-02-09/SPR230-01-1F)

Compaction on the Longitudinal Construction Joint in Asphalt Pavement, John Fleckenstein, David Allen and David Schultz, March 2002. (KTC-02-09/SPR230-01-1F)

Transportation Finance: Kentucky's Structure and National Trends, Merl Hackbart, Suzanne Perkins, and Miriam Fordham, March 2002. (KTC-02-11/SPR255-02-1F)

Enterprise Information System Analysis, Theodore Grossardt and Joel Brumm, April 2002. (KTC-02-12/SPR221-00-1F)

Flexural Behavior of R/C Beams Strengthened with CFRP Sheets or Fabric,

P. Alagueundramoorthy, I. E. Harik, and C. C. Chow, May 2002. (KTC-02-13/SPR200-99-1F)

Shear Strength of R/C Beams Wrapped with CFRP Fabric, P. Alaguendramoorthy, I. E. Harik and C. C. Choo, May 2002. (KTC-02-14/SPR200-99-2F)

Evaluation of the ITS Dayton Demonstration Project, Jason Yaw, Kavita Boddu and Nikiforos Stamatiadis, April 2002. (KTC-02-15/MS99-1F)

Kentucky Highway User Survey 2001, Ronald E. Longley, April 2002. (KTC-02-16/PSA-02-2F)

Experimental Maintenance Painting on Various Bridge Painting Projects, Theodore Hopwood II and Sudhir Palle, May 2002. (KTC-02-17/KH31-96-1F)

Movements and Settlements of Highway Bridge Approaches, Bernadette Dupont and David L. Allen, June 2002. (KTC-02-18/SPR220-00-1F)

Long-Term Benefits of Stabilizing Soil Subgrades, Tommy C. Hopkins, Tony L. Beckham, Charlie Sun, Bixian Ni and Barry Butcher, June 2002. (KTC-02-19/SPR196-99-1F)

2002 Safety-Belt Usage Survey in Kentucky, Kenneth R. Agent and Eric Green, July 2002. (KTC-02-20/KSP1-02-1F)

Toward Enhancing Estimates of Kentucky Heavy Truck Liabilities, Andrew McNeil, Suzanne Perkins and Merl Hackbart, August 2002. (KTC-02-21/UI1-01-1F)

Analysis of Traffic Crash Data in Kentucky (1997-2001), Kenneth R. Agent, Jerry G. Pigman, Monica L. Barrett and Eric Green, August 2002. (KTC-02-22/KSP2-01-1F)

Evaluation of Post-Interchange Guide Signs, Monica L. Barrett and Jerry G. Pigman, July 2002. (KTC-02-23/UI2-02-1F)

Safety Evaluation of New Roads, Kenneth R. Agent and Jerry G. Pigman, September 2002. (KTC-02-24/UI3-02-1F)

Experimental Maintenance Painting of I-65 in Louisville, Rick Younce, Theodore Hopwood II and Sudhir Palle, August 2002. (KTC-02-25/FR108-01-1F)

Contractor-Performed Quality Control on KyTC Projects, Donn E. Hancher, Yuhong Wary and Kamyar C. Mahboub, August 2002. (KTC-02-26/SPR-222-01-1F)

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Special Tax Audit Program

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